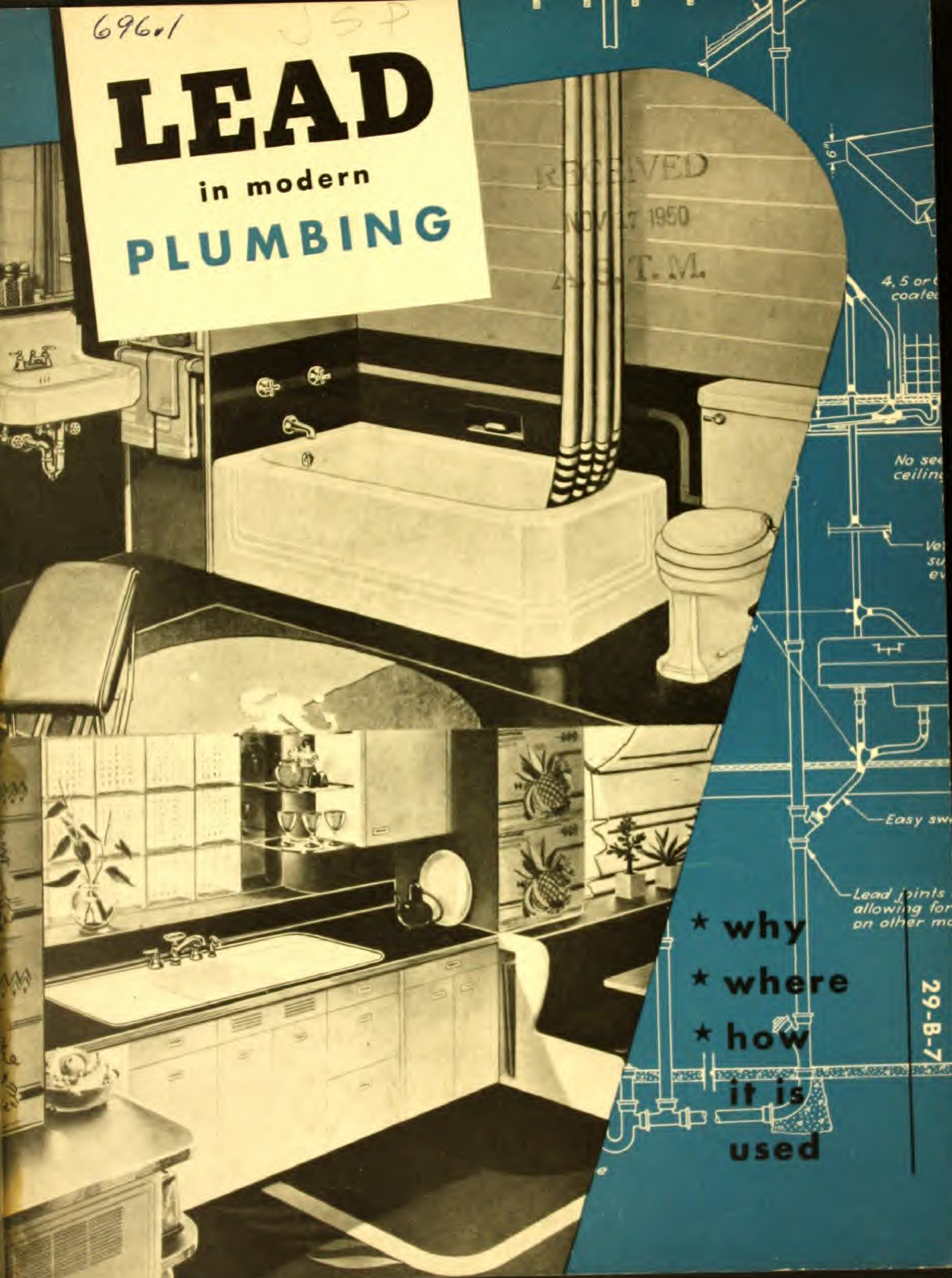
LEAD
in modern PLUMBING



★ why
★ where
★ how it is used

LEAD IN MODERN PLUMBING

Why, Where, How It Is Used

LEAD is widely used in the most modern plumbing installations. It is virtually essential for certain applications in order to make permanently sanitary jobs. Its use is permitted by practically all plumbing ordinances, required for certain purposes by many — strong proof of its superb record of performance.

If for no other reason than its flexibility which provides for settlement or differential movement occurring in practically all structures, lead is needed in modern plumbing. Yet it has many other desirable qualities, durability, smooth bore, flexibility of installation, bonded joints, being among them.

Why lead is used in modern plumbing and where in the plumbing system it is most applicable are outlined in the following pages. Also some general requirements for its best installation are included.

For further details or for assistance with specific lead plumbing problems write to

LEAD INDUSTRIES ASSOCIATION
420 Lexington Avenue
New York 17, N. Y.

Roman lead pipe manufactured between the years 69 and 79 A.D. and unearthed, 1,800 years later in excellent condition.

EARLY DEVELOPMENT

Lead plumbing and water distribution systems have a historical background of more than 2,000 years of dependable service. In the early days, its manufacture and use were extremely crude, but even so it performed surprisingly well.

The ancient Romans were among the first to recognize the value of lead pipe in the extensive water systems which were a part of their civilization. The value of cleanliness and proper waste disposal was well known to them even to the extent of such systems following their victorious armies. Evidence of this is found in Bath, England, where they developed a water supply system using lead pipe that is still in evidence.

A particularly good example of old Roman lead pipe is shown in the illustration. The raised inscription on it reads: "IMP. CAES. AUG. VESPASIANA SUB CURA CALLISTI AUG. L. PROCURATORIS," or in English "(Manufacture of the) Emperor Caesar Augustus Vespasian, under the charge of Callistus, freedman of the emperor, manager." As Vespasian reigned from 69 to 79 A.D., the pipe when excavated in 1907 had been in the ground for more than 1,800 years. This certainly speaks for the durability of lead pipe underground.

Definite evidence has been left to us that the Romans had a flourishing lead pipe manufacturing industry, with diameters and lengths standardized. The pipe was made oval in cross-section and from all indications was made by casting sheet lead to the required thickness and width and then bending the sheet until the edges touched, whereupon these edges were fused together by one of two ways, either by building a fire or running molten lead along the seams.

Through the years lead since those crude beginnings has always been an important material of plumbing and still is today. But during that time methods of manufacture and use have been developed to a high degree of perfection, resulting in greatly improved products with a high degree of quality control that can be counted upon to perform better than ever.

Lead pipe of modern day manufacture. From the crude beginning of lead pipe manufacture to today's quality controlled product, lead has served the plumbing industry well.

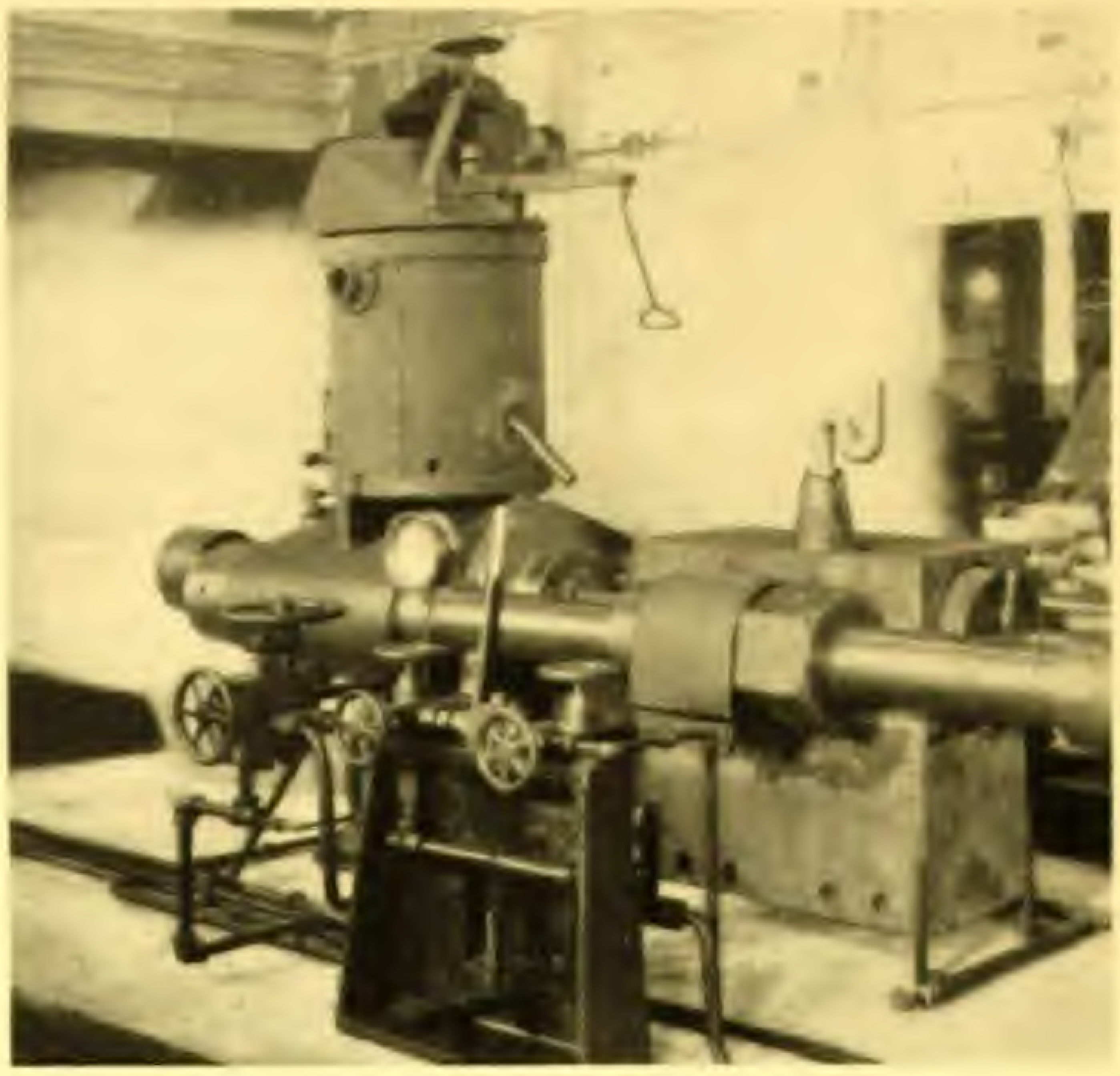
HOW LEAD PIPE AND FITTINGS ARE MADE

The seamless smooth inner bore of lead pipe and fittings is a result of the method of manufacture in use today. Large extrusion presses exerting pressures up to 750 tons literally squeeze the lead through dies forming the pipe.

At the top of the press is a ram or nozzle with a hole in the center. This hole in the ram controls the outside diameter of the pipe. The lower half of the press is a cylinder holding up to 1,000 lb. of lead into which molten lead is poured and allowed to solidify. In the center of the cylinder is a mandrel or steel rod which controls the inside diameter of the pipe.

The lower half of the press, the cylinder, is forced against the ram under hydraulic pressure, forcing the lead through the space between the mandrel and hole in the ram. The pipe thus produced is uniform in wall thickness of long continuous lengths and seamless.

In the production of lead traps and bends, the principle is the same though the operation is quite different. Two hydraulic presses with cylinders set in horizontal line form an integral unit with a single die and mandrel in the center. Each of the presses is operated independently and the cylinders on both sides of the mandrel are loaded with lead. At the beginning of the operation, in the production of a bend for example, equal pressure is at first applied forcing the lead out uniformly around the mandrel. At the point where the bend is to be made, greater pressure is applied to one cylinder forcing more lead out that side, thereby creating the bend in the lead. As soon as the bend is completed, the pressure is equalized in both cylinders and production of the straight section of the bend is continued until the required length, when it is cut off. The operation is completed much more rapidly than can be explained. By proper manipulation of the pressure controls, skillful operators can almost write their names in lead.



Extrusion press for making lead traps and bends. Pressure on the two lead cylinders is controlled independently by the controls shown in the foreground.

STANDARDS OF QUALITY

Some years ago, the Lead Industries Association with the cooperation of the manufacturers of lead pipe, fittings and calking lead adopted Standards that closely controlled metal purity, wall thickness, concentricity and weight. Manufacturers producing products meeting the rigid standards are licensed by the Association to stamp the "Seal of Approval" insignia on such products. The Association, through the licensing agreement, could withhold or take away permission to use the "Seal" if products not meeting the standards were found.

Thus added assurance of long life and trouble-free service expected of lead pipe, fittings and calking lead is provided the users of such products.

Lead bend affixed with the "Seal of Approval," indentification of high quality product meeting recognized standards.

That these Standards were promulgated not for the benefit of the manufacturer, but rather for the benefit of the consumer is aptly shown by the specifications and standards for these same products adopted by the Federal Government. The Government Standard, Federal Specification WW-P-325, Pipe, Bends and Traps; Lead (For) Plumbing and Water-Distribution, and Commercial Standard CS94-41 Calking Lead, are identical in substance with those adopted by the Association and to which manufacturers using the "Seal of Approval" must conform.

The foregoing Standards and Specifications are available, free of charge, from the Lead Industries Association.

Lead Trap and Bend Standards

HALF S OR P TRAPS

		Short Traps				*Long Traps*			
		Dimensions		*Total Weight*		*Dimensions*		*Total Weight*	
Nominal Inside Diameter (Inches)	*Weight per Running Foot (Pounds)*	*Inlet (Inches)*	*Outlet (Inches)*	*(Pounds)*	*(Ounces)*	*Inlet (Inches)*	*Outlet (Inches)*	*(Pounds)*	*(Ounces)*
$1\frac{1}{4}$	$2\frac{5}{8}$	$4\frac{1}{2}$	7	4	0	$4\frac{1}{2}$	14	5	9
$1\frac{1}{2}$	$3\frac{1}{8}$	$4\frac{1}{2}$	7	4	15	$4\frac{1}{2}$	14	6	12
2	$4\frac{1}{8}$	$4\frac{1}{2}$	8	7	2	$4\frac{1}{2}$	14	9	3

DRUM TRAPS

Trap Sizes (Inches)	*Thickness of Cap and Flange (Inches)*	*Length of Thread and Ring (Inches)*	*Screw Cap and Ring Thread*
4 x 8 4 x 9 4 x 10	5/32	9/16	3-inch straight pipe thread, 8 threads per inch, free-fit (nominal pitch diameter, 3.388 inch).
3 x 8 3 x 9 3 x 10	5/32	7/16	2-inch straight pipe thread, $11\frac{1}{2}$ threads per inch, free-fit (nominal pitch diameter, 2.296 inch).

BENDS

$1\frac{1}{2}$-inch Nominal Inside Diameter			*3-inch Nominal Inside Diameter*			*4-inch Nominal Inside Diameter*		
Dimensions (Inches)	*Total Weight (Pounds)*	*Total Weight (Ounces)*	*Dimensions (Inches)*	*Total Weight (Pounds)*	*Total Weight (Ounces)*	*Dimensions (Inches)*	*Total Weight (Pounds)*	*Total Weight (Ounces)*
4 x 7	2	12	$5\frac{1}{2}$ x 10	7	3	$5\frac{1}{2}$ x 10	9	5
4 x 12	4	1	$5\frac{1}{2}$ x 12	8	3	$5\frac{1}{2}$ x 12	10	10
4 x 15	4	13	$5\frac{1}{2}$ x 15	9	12	$5\frac{1}{2}$ x 15	12	10
4 x 18	5	10	$5\frac{1}{2}$ x 18	11	4	$5\frac{1}{2}$ x 18	14	10
4 x 20	6	2	$5\frac{1}{2}$ x 20	12	4	$5\frac{1}{2}$ x 20	16	0
7 x 7	3	8	10 x 10	9	8	10 x 10	12	5
7 x 12	4	13	10 x 12	10	8	10 x 12	13	10
7 x 15	5	10	10 x 15	12	0	10 x 15	15	10
7 x 18	6	6	10 x 18	13	8	10 x 18	17	10
7 x 20	6	15	10 x 20	14	8	10 x 20	18	15

Lead Pipe Standards

Size Inside Diameter (Inches)	*Class of Pipe*[1]	*Commercial Designation*[2] *East*	*West*	*Wall Thickness (Inches)*	*Minimum Outside Circumference (Inches)*	*Weight Per Foot* *Pounds*	*Ounces*
				WATER SERVICE PIPE			
3/8	50	A	S	0.145	2 1/16	1	4
	75	AA	XS	0.175	2 1/8	1	8
	100	AAA	XXS	0.256	2 5/8	2	8
1/2	50	A	S	0.149	2 3/8	1	8
	75	AA	XS	0.188	2 5/8	2	0
	100	AAA	XXS	0.256	3 1/16	3	0
5/8	50	A	S	0.197	3 1/16	2	8
	75	AA	XS	0.228	3 1/4	3	0
	100	AAA	XXS	0.256	3 7/16	3	8
3/4	50	A	S	0.203	3 1/2	3	0
	75	AA	XS	0.231	3 11/16	3	8
	100	AAA	XXS	0.293	4 1/16	4	12
1	50	A	S	0.214	4 5/16	4	0
	75	AA	XS	0.246	4 9/16	4	12
	100	AAA	XXS	0.298	4 7/8	6	0
1 1/4	50	A	S	0.210	5 1/8	4	12
	75	AA	XS	0.258	5 3/8	6	0
	100	AAA	XXS	0.320	5 13/16	7	12
1 1/2	50	A	S	0.242	6 1/16	6	8
	75	AA	XS	0.288	6 3/8	8	0
	100	AAA	XXS	0.386	7	11	4
2	50	A	S	0.252	7 3/4	8	12
	75	AA	XS	0.376	8 1/2	13	12
	100	AAA	XXS	0.504	9 5/16	19	8
				SOIL AND WASTE PIPE			
1 1/4	. . .	D	XL	0.118	4 1/2	2	8
		C	L	0.139	4 11/16	3	0
		B	M	0.171	4 7/8	3	12
1 1/2	. . .	D	XL	0.138	5 7/16	3	8
		C	L	0.165	5 5/8	4	4
		B	M	0.191	5 3/4	5	0
2	. . .	D	XL	0.142	7 1/16	4	12
		C	L	0.177	7 1/4	6	0
		B	M	0.205	7 7/16	7	0
2 1/2	. . .	D	XL	0.125	8 1/2	5	0
		B	M	0.250	9 5/16	10	10
3	. . .	D	XL	0.125	10 1/16	6	0
		B	M	0.250	10 7/8	12	8
4	. . .	D	XL	0.125	13 3/16	8	0
		B	M	0.250	14	16	6
5	. . .	D	XL	0.125	16 3/8	10	0
		B	M	0.250	17 1/8	20	4
6	. . .	D	XL	0.125	19 1/2	11	12
		B	M	0.250	20 1/4	24	2

[1]Class of pipe also indicates maximum working pressure in pounds per square inch.

[2]Designations ordinarily used east and west, respectively, of the Illinois-Indiana State line.

LEAD SERVICE PIPE

Lead pipe has long been recognized as the standard material for water service connections between the main and dwelling. Many of the larger cities of the country insist that lead pipe be used for sizes 2 in. and under, particularly where conditions are severe.

Performance

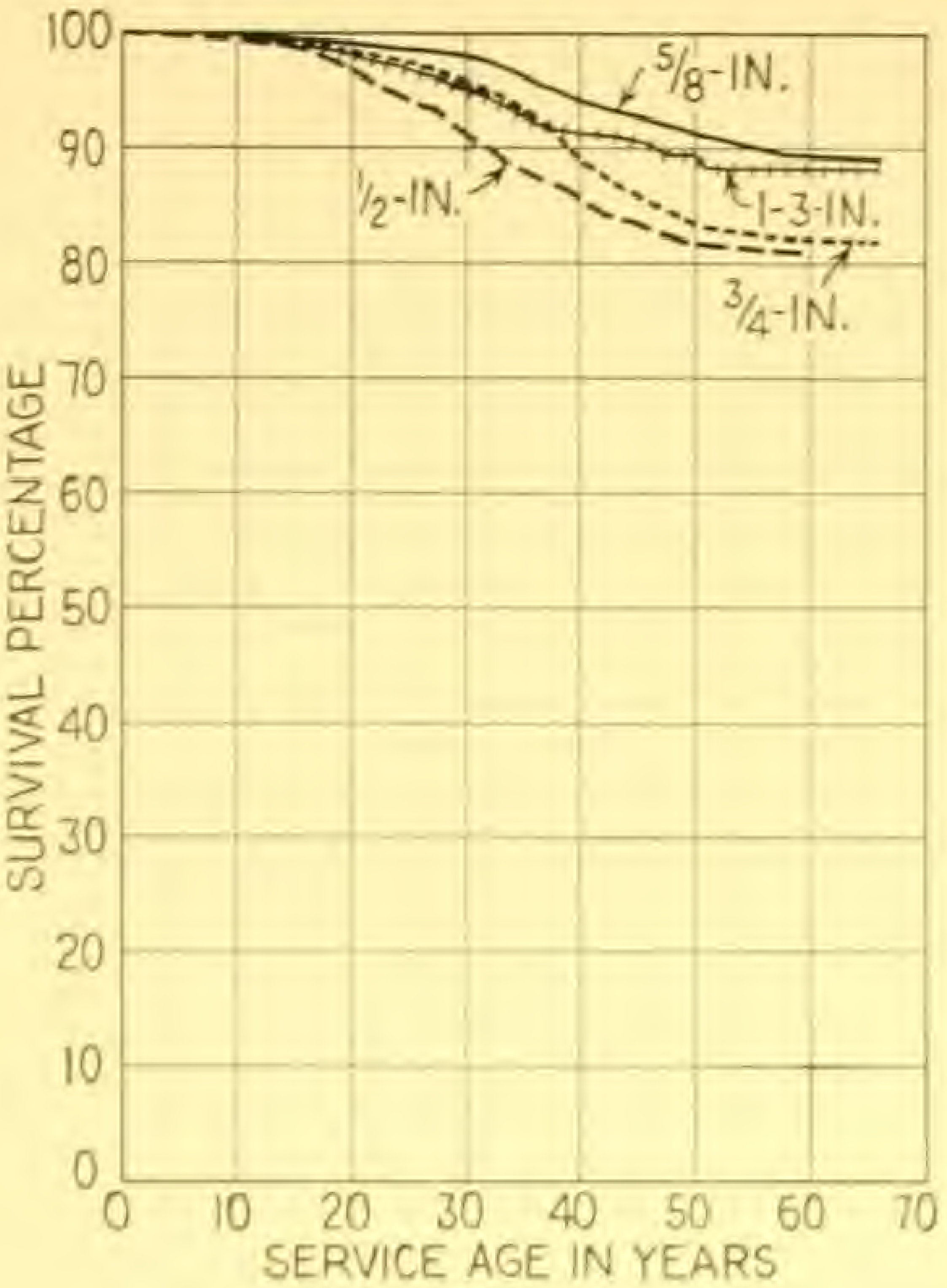
Wherever lead service pipe has been used, experience has shown its performance to be remarkable. A recent example of the long life that can be expected of lead service pipe was part of a survey made by the American Water Works Association on the survival and retirement of water works facilities which appeared in the August, 1945, issue of the official "Journal" of that Association.

The study was made from the files of the Denver Municipal Water Works, Denver, Colo., and covered the entire distribution system, going back to the original establishment of a public water supply in 1872. At the time the survey was made, practically all of the services were lead. It is clearly revealed in this study how well lead service pipe endures through long periods of time. For example, the records show that of the 75,729 lead services in sizes from $\frac{1}{2}$ to 3 in. installed since 1875, *only* 5.1 percent have been retired. The record is even better when it is considered that *retirement* does *not* necessarily imply *failure* inasmuch as changes and development, particularly in the older parts of the city, may have necessitated larger services than were initially installed. In addition, the retirement of 46.4 percent of 575,759 ft. of galvanized iron mains in sizes of 1 to $2\frac{1}{2}$ in. installed since 1884, undoubtedly accounted for some of the lead service pipe retirements. A chart showing the survival percentages in relation to age of lead water services prepared from the data revealed in the Denver study is shown.

Other illustrations show lead service pipe being installed in Chicago, New Orleans and New York, these cities using lead services almost exclusively. Because of their size, this particular group probably offer the most trying conditions to any service pipe. Traffic is of course considerably heavier than in the smaller cities and the service pipes must be able to withstand the heavy vibration and movement caused by this traffic. In Manhattan, New York City, for example, in addition to the heavy auto, bus and truck traffic overhead, the continuous thundering of subway trains which are never

Lead service pipe being installed in New York, left, Chicago, center, and New Orleans, right.

These are among the many cities that use lead exclusively or almost exclusively for services 2 in. and under.



Survival percentages of lead water services with relation to age from a study made in Denver, Colo.

very far away from practically any spot on the island, offer still another obstacle to long and trouble-free life that should be expected of the water service pipe material. That lead is performing satisfactorily under these grueling conditions is shown by the fact that practically all of the water service lines 2 in. and under, installed in Manhattan, are lead. A recent communication from Mr. Joseph J. Halliday, chief inspector, Bureau of Water Supply, Manhattan, stated: "Most certainly the sub-surface conditions in the Borough of Manhattan are the most severe tests for service pipes that may be found anywhere and, through years of experience, it has been found that lead, due to its flexibility and its resistance to corrosion, is one of the best materials for service pipes 2 in. and less in diameter."

The performance of lead services under these difficult conditions is of course one of the most important reasons why it is preferred by large and small cities alike. Such smaller cities as Newark, N. J., Shreveport, La., Springfield, Ill., Fort Worth, Tex. and St. Paul, Minn., use lead service pipe almost exclusively. These cities are examples only and the list is by no means complete.

Their experience has been almost identical with that of the larger cities and it is not uncommon to find lead services performing perfectly in any of these cities after 40, 50 or more years.

Cost

The initial cost of lead pipe because of its greater wall thickness and weight may be more than other materials. However, it can be written off over a longer period of life. This is graphically shown in the Denver, Colo., study made by the American Water Works Association and described in the previous section.

As most services are installed under lawns and pavements, expensive repairs requiring these to be torn up are minimized and replacements reduced by the use of durable lead. Actually the cost of the service material is only a small part of the overall cost of such an installation.

As a concrete example, the following table of itemized costs of four water services, selected at random from the files of the water division of a large eastern city show the relationship between the cost of a lead water service pipe itself and of the total cost of the installation:

Percentage Cost of Installing Lead Water Service Pipe

	(1)	(2)	(3)	(4)
Length	*12'0"*	*31'0"*	*22'0"*	*10'6"*
Tap and Coupling	1.3%	1.0%	1.1%	1.3%
Curb Stop	3.1	2.4	2.7	3.0
Wiped Joints	1.7	1.3	2.2	1.6
Curb Box	2.4	1.8	2.0	2.3
Plumber	8.6	6.5	7.5	8.2
Engineer (Compressor)	4.3	3.3	3.7	4.2
Chauffeur	5.1	3.4	4.4	4.9
Labor	23.1	29.7	26.5	26.3
Overhead	12.8	13.9	12.9	12.8
Gasoline	0.4	0.3	0.3	—
Paving Repair	30.9	23.8	26.7	30.0
1 in. Lead Pipe	6.3	12.6	10.0	5.4
Total	100.0	100.0	100.0	100.0

It will be noted that in no case does the cost of the pipe amount to more than 12.6 percent of the cost of the installation. If the use of a less durable material than lead had made possible a saving of as much as 25 percent in the cost of the pipe, it would have resulted in a saving of only 3.2 percent of the cost of the total installation of service No. 2 and even less in the cost of the shorter lines.

When consideration is given to smallness of actual savings that can be made by sacrificing durability to price it seems poor economy to install anything but the most durable material. It is certain that such savings could never compensate for the expense created by the failure of even one installation, which would result in early repetition of all other costs amounting to about ten times the first cost of pipe or forty times the probable initial saving.

Safe Working Pressure of Lead Service Pipe

Class of Lead Pipe	*Application*	*Maximum Working Pressure, Pounds per Square Inch*	*Nominal Inside Diameter (Inches)*	*Commercial Designation East*	*Commercial Designation West*
100	Service and supply	100	3/8 to 2, inclusive	AAA	XXS
75	Service and supply	75	3/8 to 2, inclusive	AA	XS
50	Service and supply	50	3/8 to 2, inclusive	A	S

How Lead Service Pipe Is Installed

There are three classes of lead service pipe, each designed to function within certain ranges of water pressure. The above table taken from Federal Specification WW-P-325 describes these in detail.

Lead service pipe is supplied in coils of considerable length determined by the weight of pipe selected. Very few service installations require more than one coil, as a matter of fact, a single coil will usually be enough for two or more installations.

A sufficient length of lead pipe of the proper class for the pressure to be handled is cut from the coil, allowing for a gooseneck and reasonable slack to bypass any obstacles in the trench. Allowance for the gooseneck needed for the various sizes of lead pipe is shown in the accompanying table. The pipe may be measured in the coil, and fittings may be attached to the portion to be used without uncoiling.

Lead service showing ample gooseneck bent integrally into the pipe making ample provision for settlement. This installation connects an old lead service to the new main.

The corporation stop tailpiece, preferably the angle type, is wiped to the water main end of the lead pipe and the curb stop, union or other connecting unit is joined to the house end of the service. This much of the service installation is easily done in the shop.

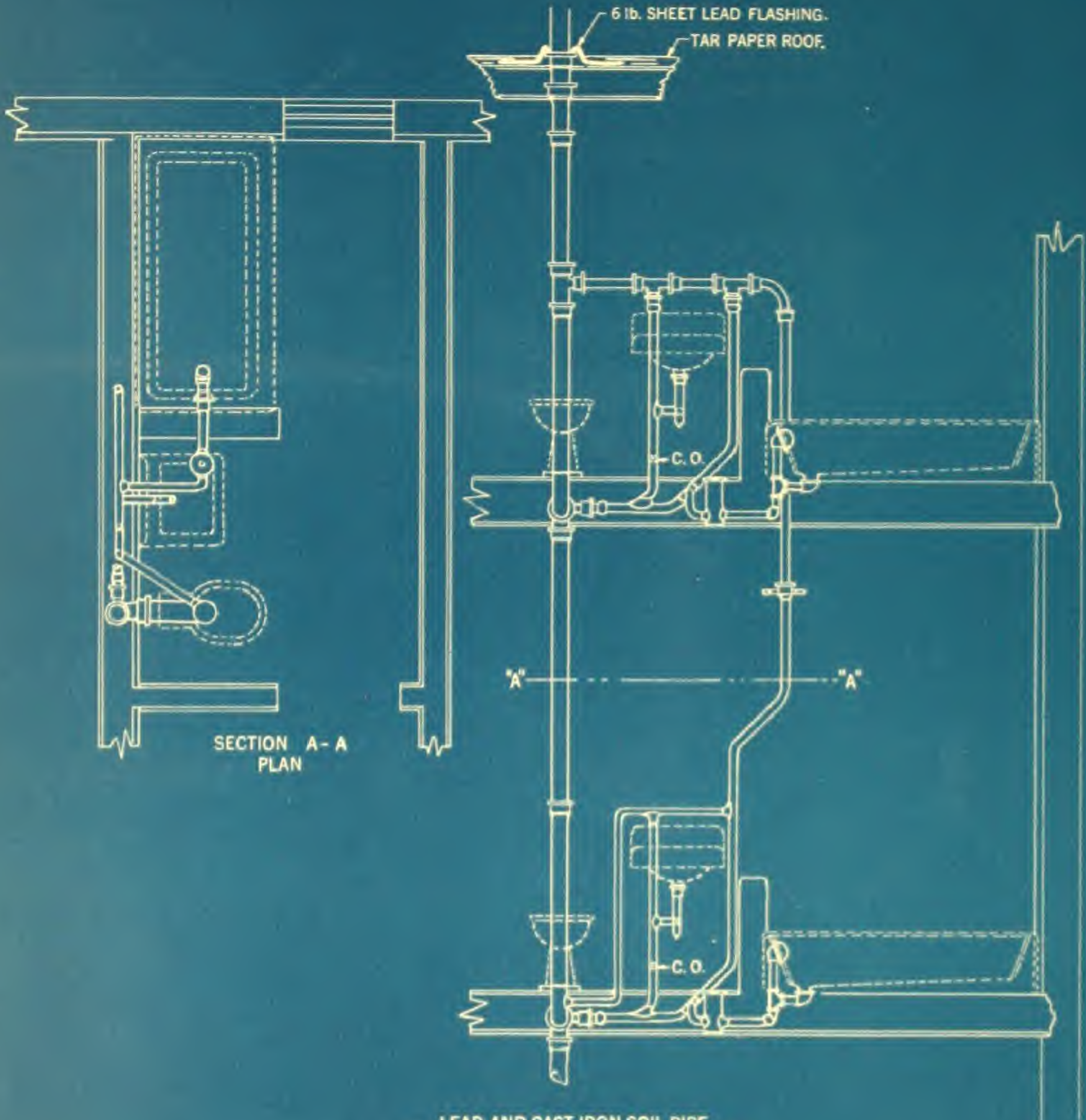
The prepared lead service is then placed in the trench with a half "S" shaped gooseneck extending to the right when facing the main so that any settlement will tighten rather than loosen the corporation cock union. The gooseneck should also lie horizontal to prevent trapping.

In rocky soil, pipe should be bedded in sand or earth and covered with six to eight inches of sand or loose earth before back-filling. In corrosive soils such as muck or cinders or in locations where severe electrolysis may be expected, the lead service should be layed in a wood or tile trough and covered with hot pitch.

Lead Service Pipe

Length of Gooseneck and Length of 100 Lb. of Pipe

Inside Diameter (Inches)	*Length of Pipe in Gooseneck (Feet)*	*Width Across Gooseneck (Feet)*	*Number of Feet in 100 Pounds*
CLASS 50 (A or S Weight) For Pressures up to 50 Pounds Per Square Inch			
3/4	2	1 1/4	33.3
1	2	1 1/4	25.0
1 1/4	2 1/2	1 1/2	21.0
1 1/2	3	1 7/8	15.5
2	4	2 1/2	11.3
CLASS 75 (AA or XS Weight) For Pressures up to 75 Pounds Per Square Inch			
3/4	2	1 1/4	28.5
1	2	1 1/4	21.0
1 1/4	2 1/2	1 1/2	16.6
1 1/2	3	1 7/8	12.5
2	4	2 1/2	7.2
CLASS 100 (AAA or XXS Weight) For Pressures up to 100 Pounds Per Square Inch			
3/4	2	1 1/4	21.0
1	2	1 1/4	16.6
1 1/4	2 1/2	1 1/2	12.9
1 1/2	3	1 7/8	8.8
2	4	2 1/2	5.1

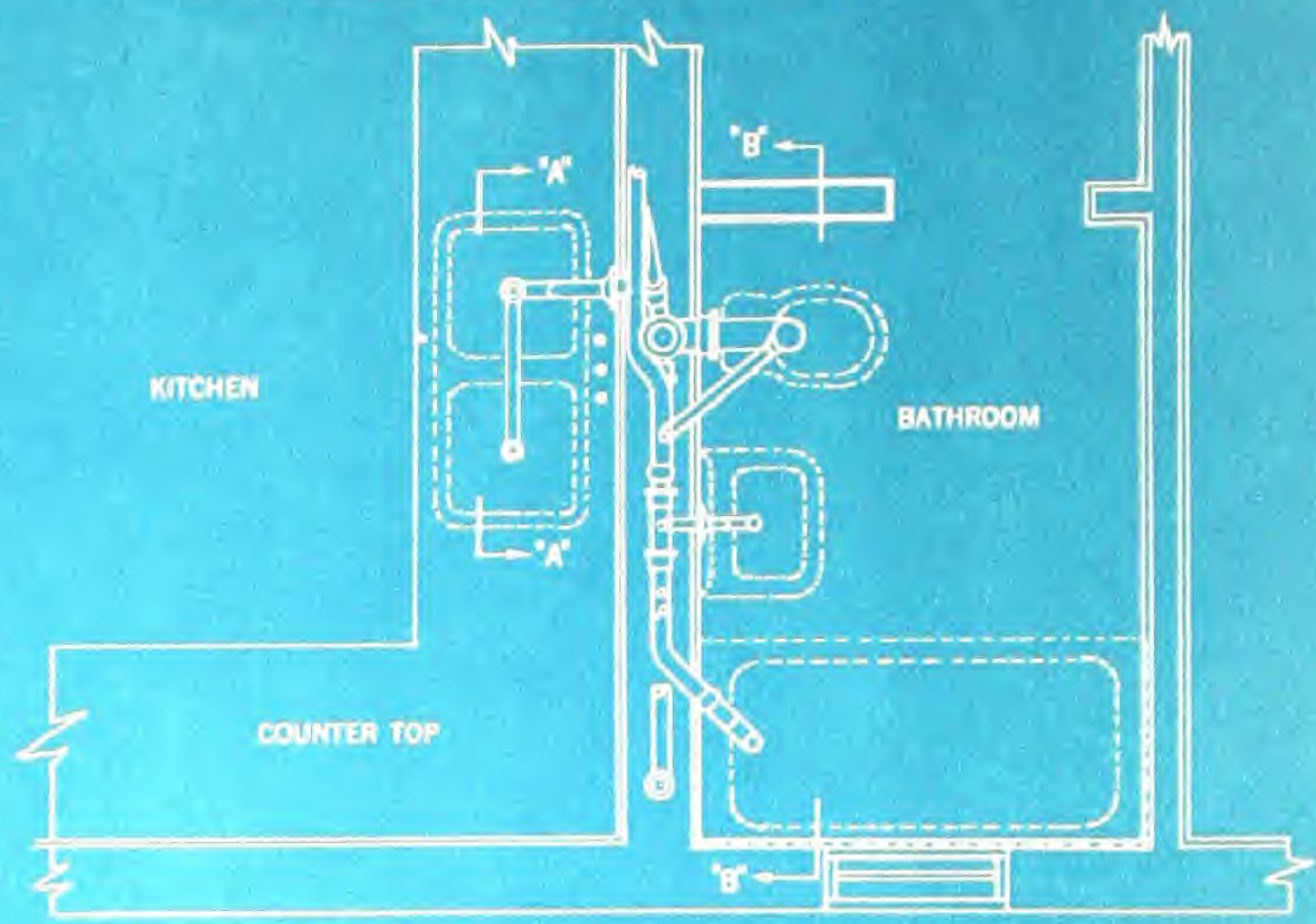


LEAD AND CAST IRON SOIL PIPE
ROUGHING-IN-FOR TWO STORY BUILDING

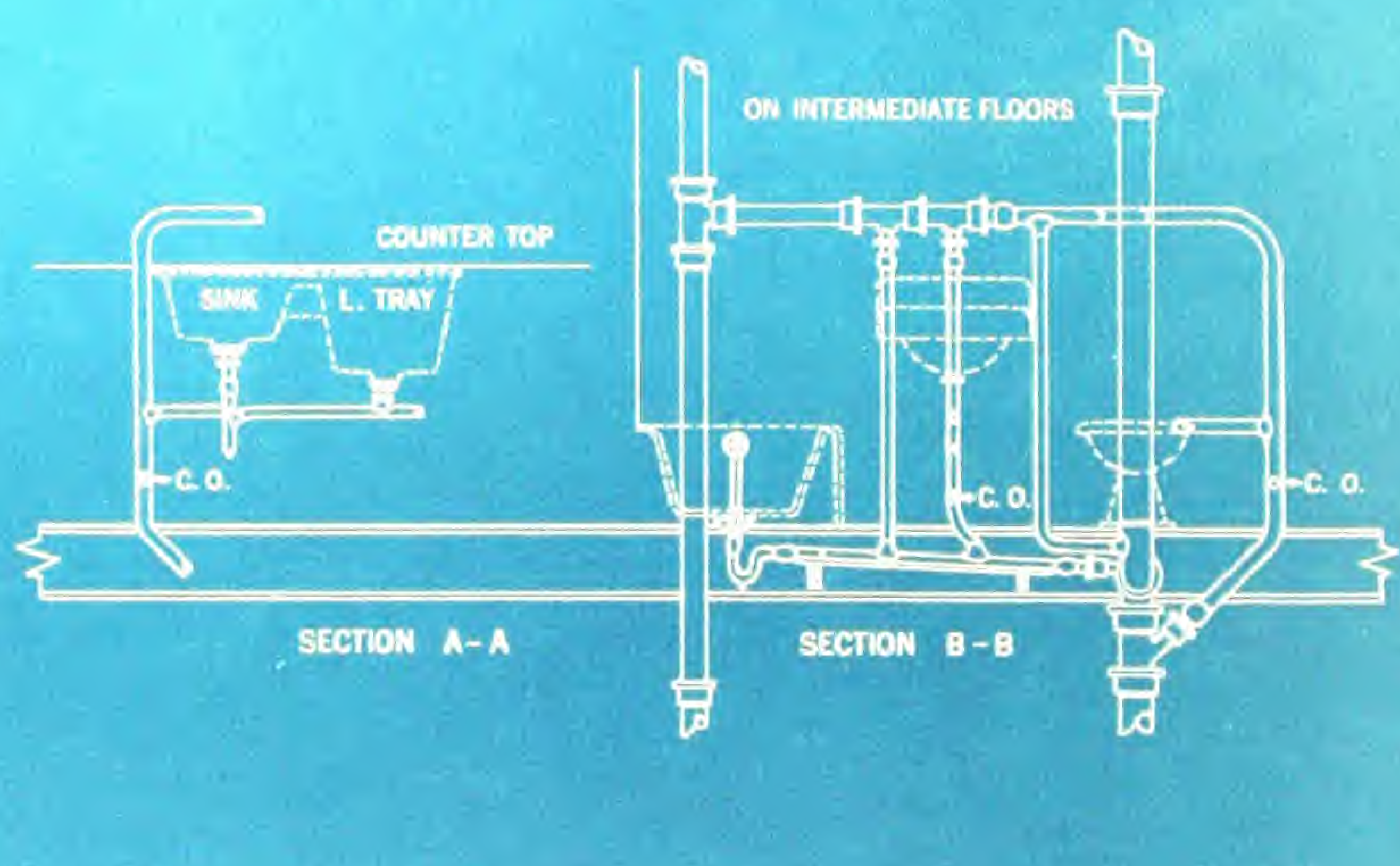
WATER CLOSET BENDS - 4" X 3" X. H. LEAD REDUCING BENDS
BATH TRAPS 4" X 9" X. H. LEAD DRUM TRAPS.
OR 1½" X. H. LEAD "P" TRAPS.
WASTE AND VENT PIPE - 2" AND 1½" CLASS "D" LEAD.
SOIL AND VENT STACKS - 3" AND 2" CAST IRON SOIL PIPE.

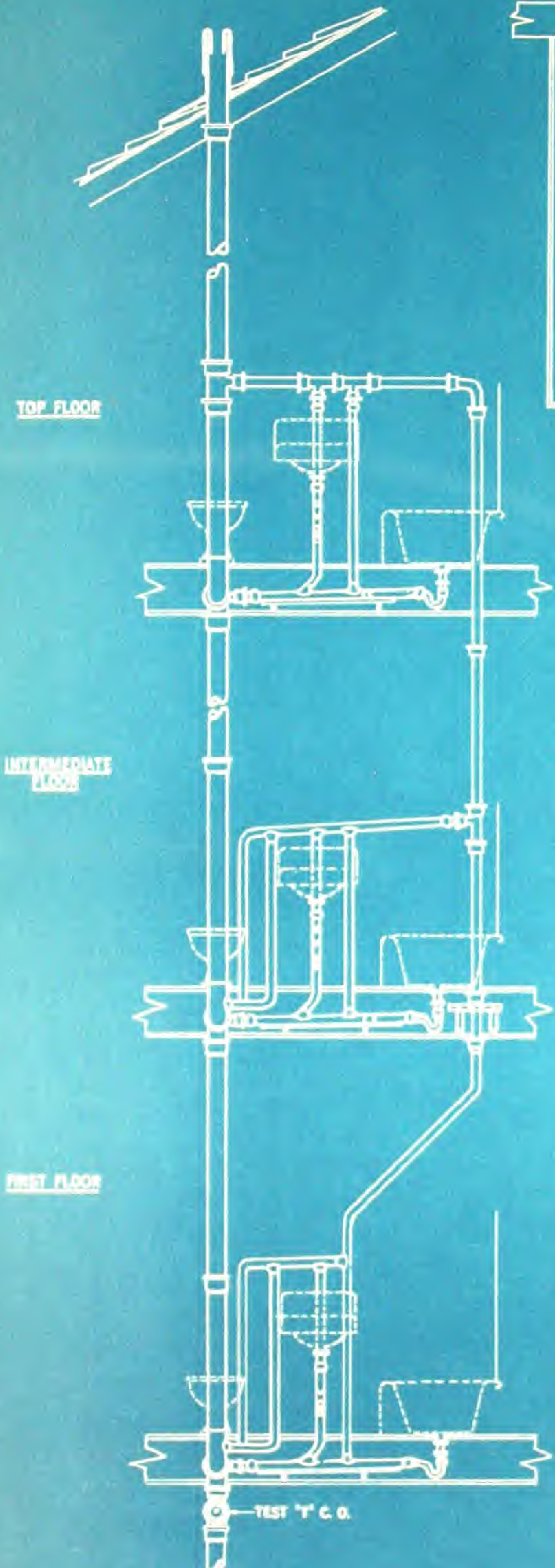
MULTIPLE STORY BUILDING
SINGLE BATHROOMS

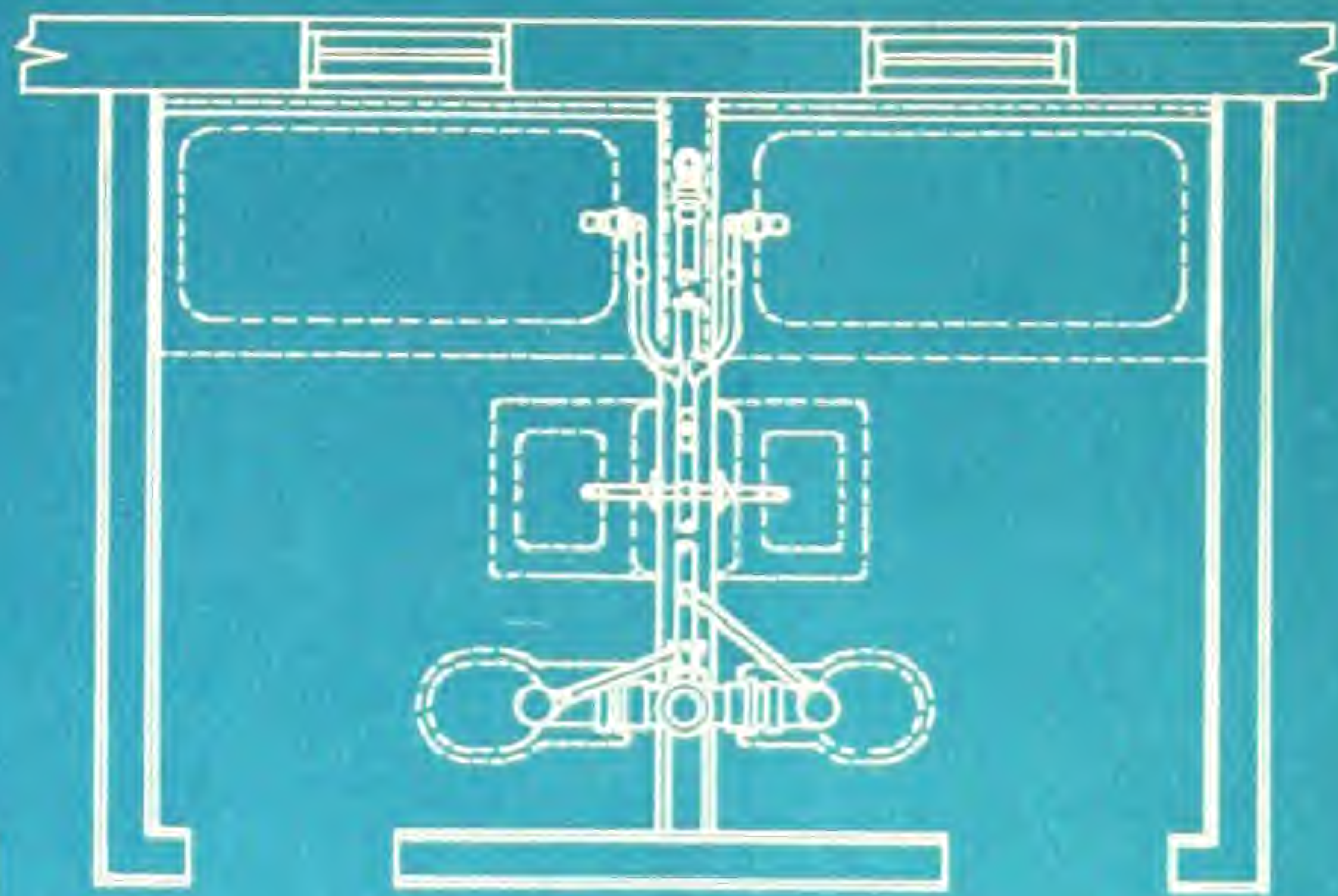
KITCHEN SINK AND LAUNDRY TRAY, ON SAME PARTITION.



WATER CLOSET BENDS, 4" X. H. LEAD.
SINK WASTE PIPE, 2" CLASS "D" LEAD.
SINK TRAPS, 1½" OR 2" X. H. LEAD.
BATH TRAPS, 1½" OR 2" X. H. LEAD.
1½" OR 2" WASTE AND VENT PIPE, CLASS "D" LEAD.
SINK C. O.– 2" BRASS PLUG WIPED IN.
ALL PIPE SIZES ACCORDING TO LOCAL PLUMBING CODE.







BATHROOMS BACK TO BACK LAYOUT
PLAN.

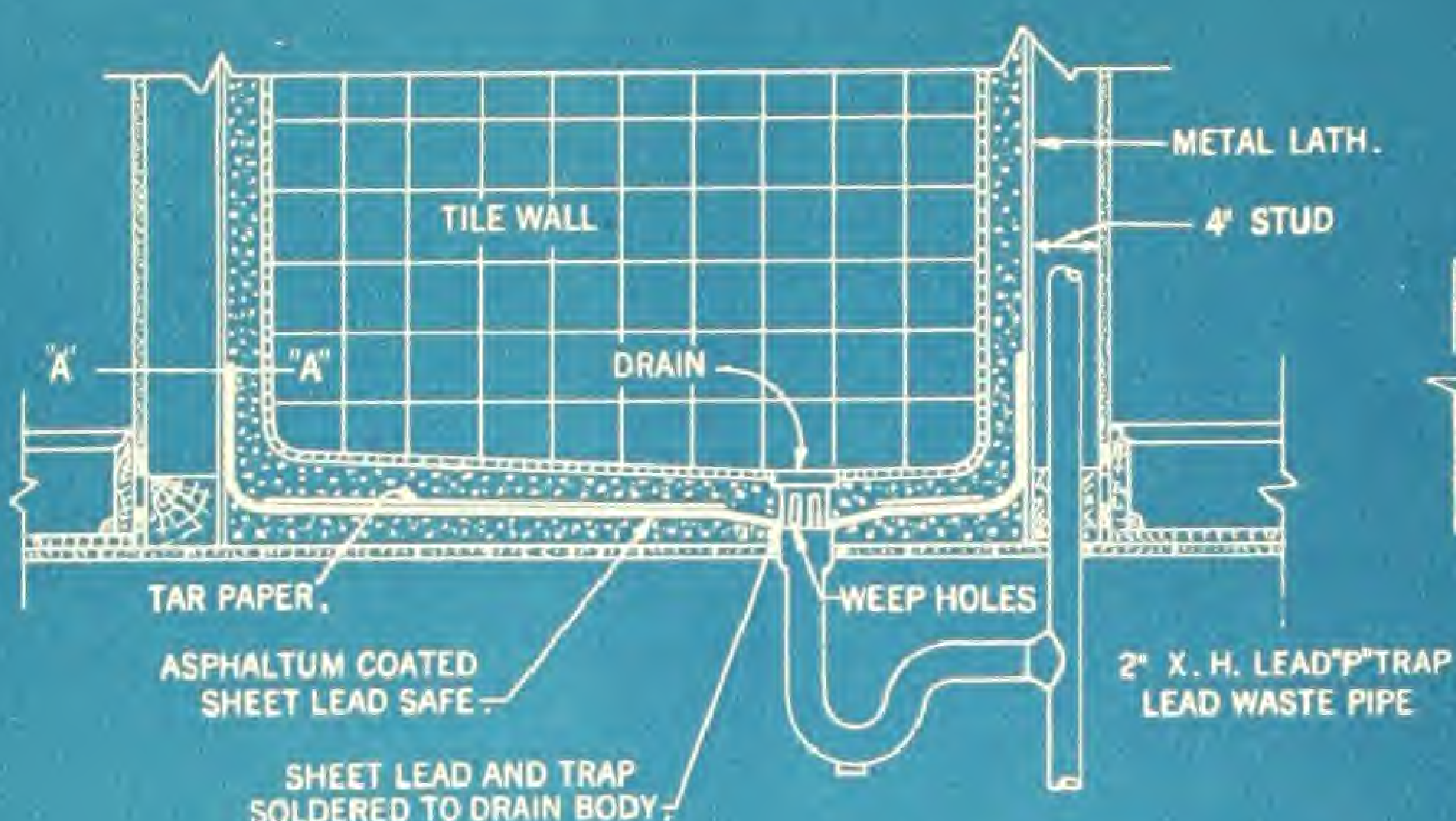
ROOF FLASHING MADE ENTIRELY OF LEAD
ANY ANGLE OR FLAT.

WATER CLOSET BENDS, 4" X. H. LEAD.
BATH TRAPS - 1½" X. H. LEAD "P" TRAP.
VENT PIPE FLASHING, 4 lb. SHEET LEAD.
WASTE AND VENT PIPES, 2" CLASS "D" LEAD PIPE.
" " " " 1½" " " " "
SOIL STACK, 4" CAST IRON SOIL PIPE.
VENT STACK, 2" " " " "
ALL PIPE SIZES ACCORDING TO LOCAL
PLUMBING CODE.

MULTIPLE STORY BUILDING BATHROOMS BACK TO BACK

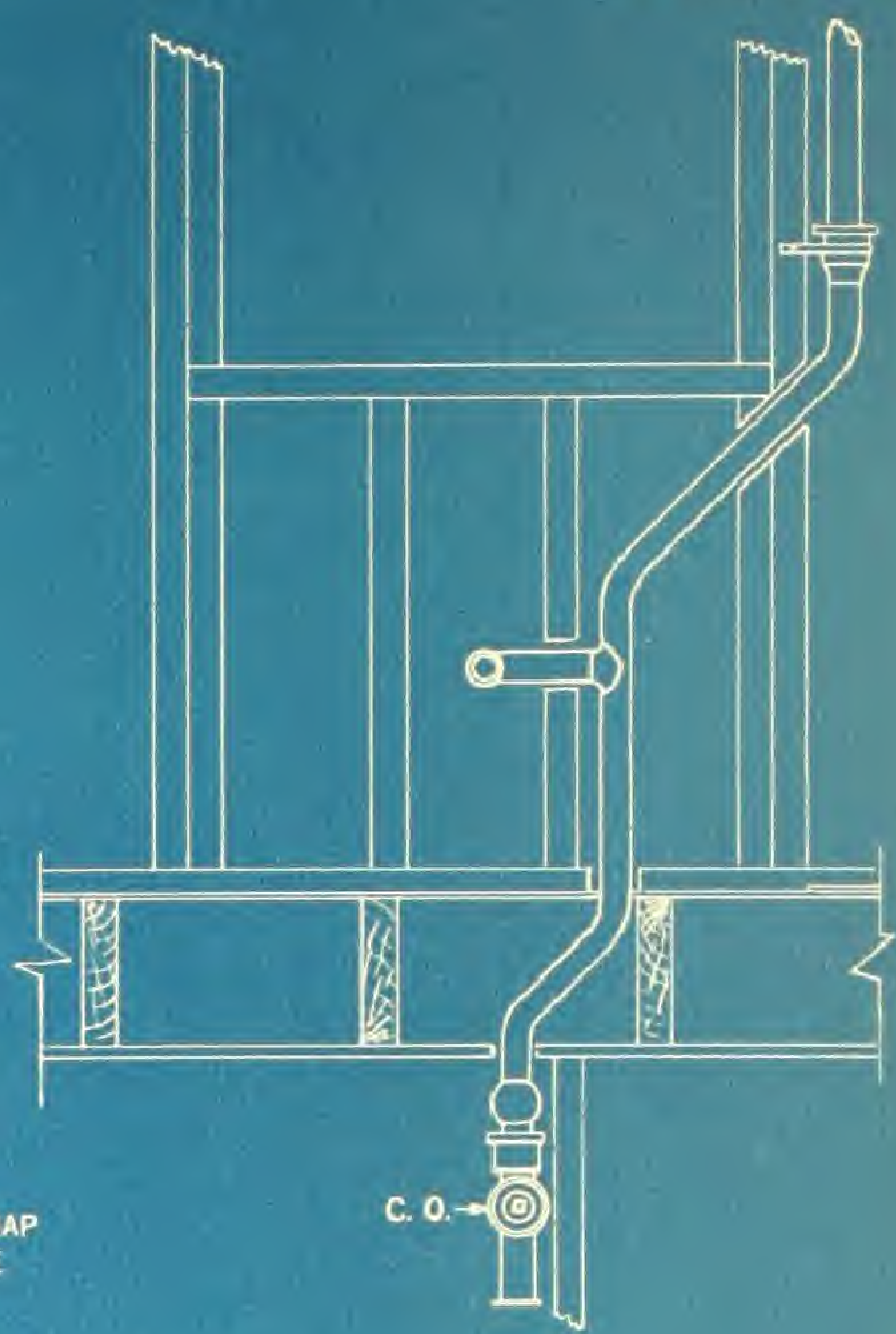
LEAD SHOWER PAN
COATED WITH ASPHALTUM.

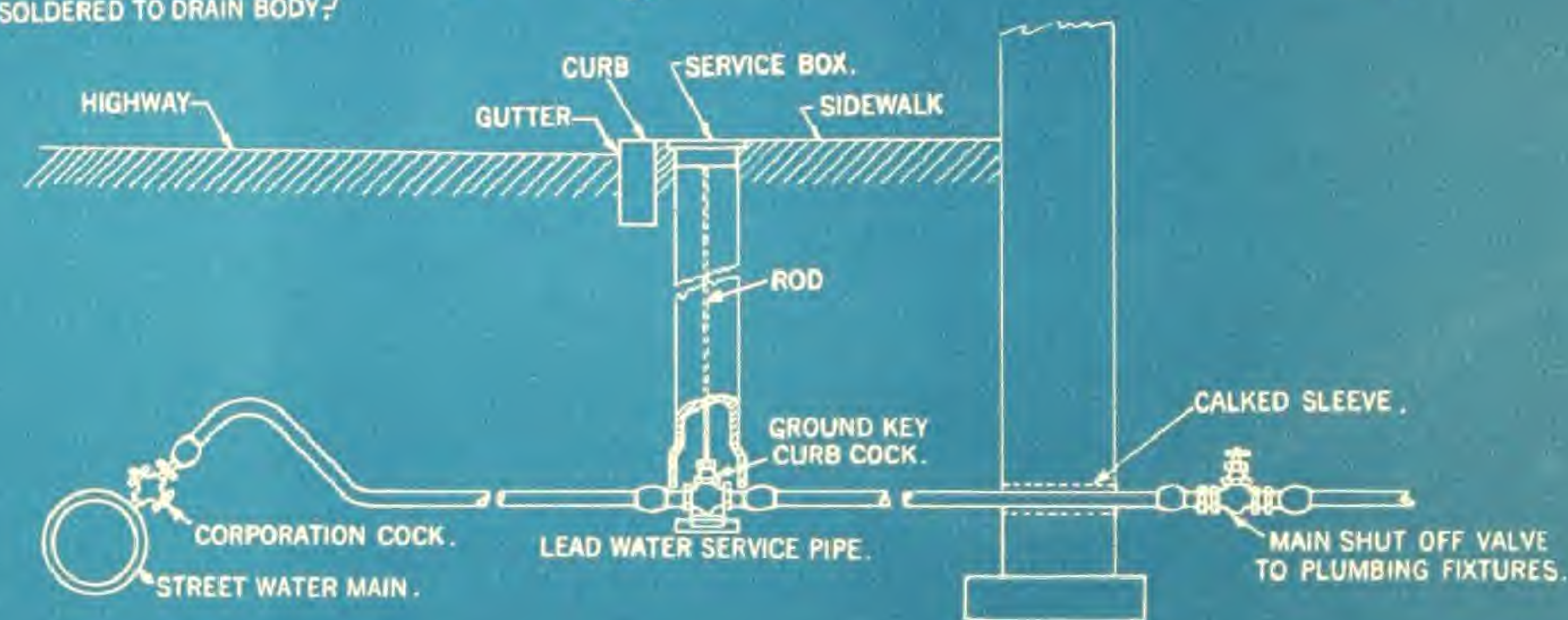
SECTION A – A



SINK UNDER WINDOW.

1½" OR 2" "D" LEAD PIPE
SINK WASTE.





LEAD INTERIOR PLUMBING

Lead pipe, bends and traps are extensively used in modern building. There is no more durable plumbing system than one of lead properly installed.

Lead is the one material that can be counted on to provide long and trouble-free service. There is evidence of lead's durability in many early American homes in which the original lead plumbing is still in use and by the plumbing codes which prohibit the use of less durable metals in inaccessible places.

Lead waste, vent and drum trap connection for second floor bath in an Albuquerque, N.M. residence.

Durability

In a recent test of various metallic materials used in soil, waste and vent lines conducted under accelerated conditions in Fort Worth, Texas, lead pipe proved to be outstanding, having a relative life expectancy of more than six times any of the other materials tested. The results of the test, outlined in a paper presented at the 1949 annual convention of the American Society of Sanitary Engineers, was prepared from data developed by the chief plumbing inspector, Department of Public Works, Fort Worth, Texas.

The test samples, of materials customarily used for soil, waste and vent lines and those recently suggested for this use, were approximately 2 ft. in length and conformed to established plumbing size specifications. The samples were placed in a wooden rack which was then placed in a manhole carrying the return sludge from the Fort Worth sewage disposal plant's aeration basin. The samples were not submerged in the sewage but were kept 18 in. above the water line. Tests of the conditions surrounding the test samples showed the sewage to be alkaline, the condensed moisture on the samples acid and the atmosphere surrounding the test pieces to contain hydrogen sulphide. Of course, being an accelerated test, the conditions of the test were more stringent than ordinarily found in the plumbing system but all of these conditions are present in the ordinary waste system to a lesser degree.

The duration of the test was one year and after this time, the weight loss of the lead, a simple method of figuring corrosion, was less than any of the other materials tested. In addition, the lead was the only material not affected by pitting, whereas all of the others were pitted in varying degrees and in one case, had pitted completely through the wall of the pipe. This particular sample had completely failed in six months.

Flexibility

Building settlement, vibration, and expansion and contraction of building materials are bound to bring about differential movement of the component parts of a building, whether it be large or small. Under these conditions, if bathroom fixtures are connected to a hard, rigid material, stresses are placed on the piping as well as the fixtures until eventually something gives. If the

Lead bends and drum traps in place for back to back bathrooms in a 200-unit housing project in Nashville, Tenn.

Stuyvesant Town, large Metropolitan Life Insurance Co. housing project in New York City. Lead bends were installed under each of the 8,755 water closets.

Preparing lead reducing bends for installation in Stuyvesant Town. Note the efficient methods used in doing lead work in the plumbing shop.

piping fails, discovery of the failure is usually made only after the water leakage has caused considerable damage to walls and ceilings and unsanitary conditions prevail. If the bathroom fixture cracks, an unsanitary condition results and expensive replacement is usually necessary.

This possible source of future replacement and repairs is easily overcome by the use of flexible lead piping and connections which yield sufficiently to take up this movement without damage or strain.

A particularly vulnerable spot in the bathroom is the water closet connection to the rigid soil stack. This important connection, because of the unsanitary conditions that can result in the event of failure, should be such that it will absorb stresses and strains without destruction to itself. No other material can do this as well as lead bends or stubs and this is borne out by the fact that their use is practically universal and in many areas compulsory. Further, the smooth inner surface of lead pipe and fittings offer little opportunity for solids to lodge and clog the pipe.

To the protection of fixtures provided by the flexibility of lead is an added advantage. Fixtures are set more easily and quickly because lead piping may be bent, by hand, to make up for slight inaccuracies in measurements.

All lead roughing in for a single story residence in Waco, Texas, left, and center, two story residence with all lead wastes and vents including a lead stack in Albuquerque, N. M. Right, a lead and cast-iron soil pipe installation in Port Arthur, Texas.

Calking a lead bend in place in White Plains, N. Y. Center, a lead stack roughing-in for back to back bathrooms prefabricated in the plumbing contractors shop. Right, a lead bend being prepared for a 265-unit apartment project in Hartsdale, N. Y.

How To Install Lead Waste and Vent Pipe

Detailed drawings on the use of lead pipe and fittings in various type buildings appear on the preceeding pages.

One of the most important details that can be noticed in these drawings is the freedom from joints wherever lead is used. Changes of direction are easily made simply by careful bending of the pipe by hand.

Lead's softness, which imparts the desirable qualities of flexibility to the pipe, also requires that simple precautionary measures be taken to see that the pipe is not damaged before and during installation. This is not to imply that it has to be handled with "kid gloves." Care should be taken to see that it is not laid against sharp edges of stones, joists, nails or other projections which might cut into it. Also the working place where the lead is prepared for installation should be cleaned free of sharp particles such as metal chips.

Vertical runs of lead pipe should be supported at intervals of approximately 4 feet by means of lead tacks soldered to the pipe and fastened to the studs or wall or by flange joints at the floor level. On horizontal runs,

Preparing lead stubs for closet connections in the Terrace Plaza Hotel, Cincinnati, Ohio. The stubs were spun closed by the manufacturer.

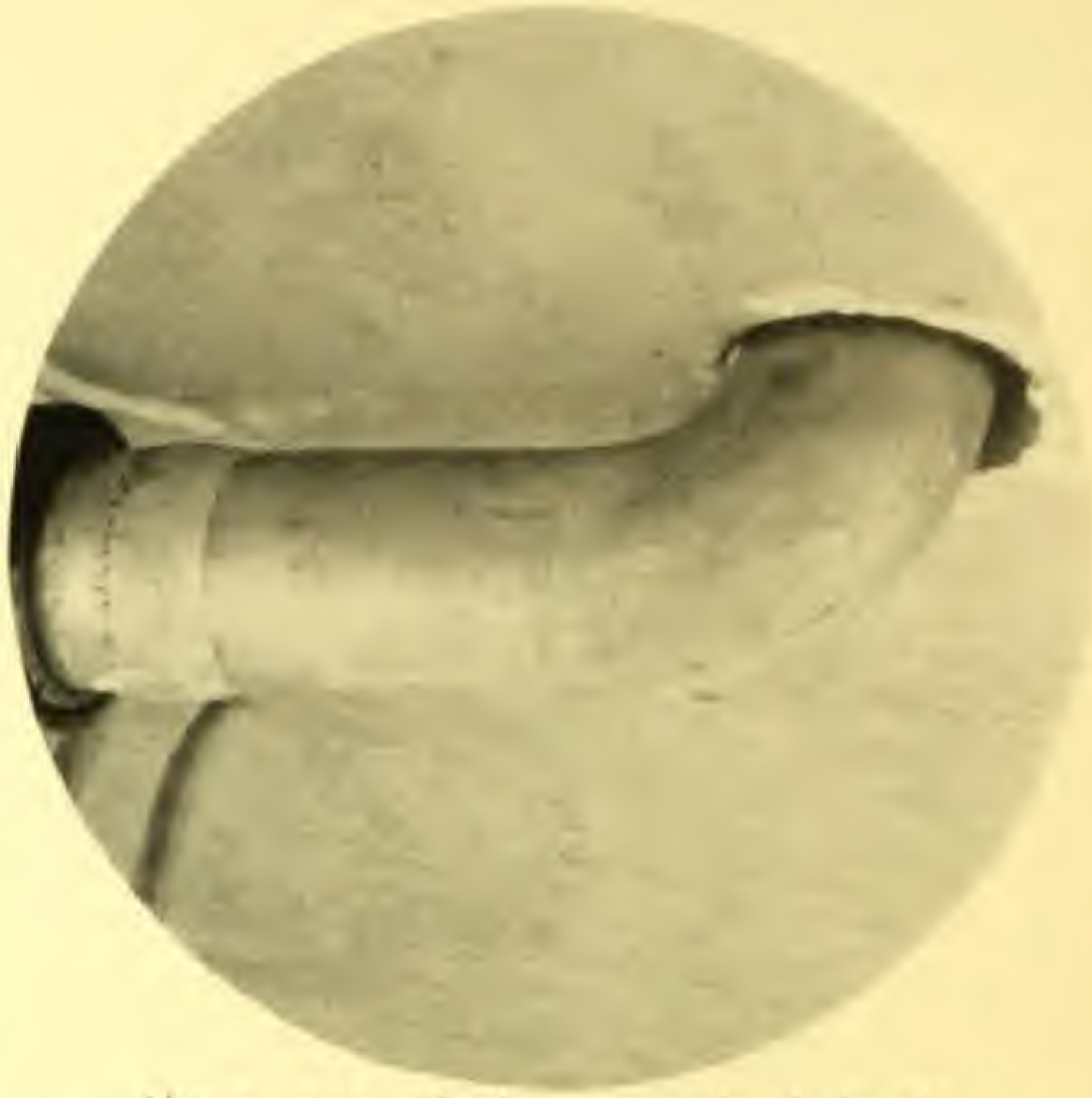
Lead fittings, wastes and vents installed in an eight-family multiple story apartment project in Austin, Texas.

Cross-sectional view of a wiped joint in lead pipe. Note that the joint does not offer any obstacles to impede flow or cause clogging.

the lead should be supported preferably over its entire length by wood strips or metal troughs fastened to the joists or hung from ceilings by means of hangers.

Three types of joints are commonly used in joining lead pipe - soldered, welded, and compression fittings sometimes used for water service pipe. Two types of soldered joints are commonly used, the wiped soldered joint and the soldered joint using an iron. The latter is used principally on cup joints and soldered joints in sheet lead for shower pans and vent stack flashings.

Wiped joints are by far the most frequently used with lead pipe and are almost invariably required in plumbing ordinances. A wiped soldered joint has one important advantage over any other type of joint used with other materials in that the joint, properly made, is stronger than the pipe itself. This is certainly not true with screw pipe. Threading the pipe cuts deeply into the wall thus seriously reducing the thickness of the pipe at its most vulnerable point.



Above, one of the many lead bends in a Chattanooga, Tenn. housing project.

Four-inch lead wastes, bends and vents installed in remodeling jobs in Omaha, Nebr., below, and Springfield, Ill., right. These lead installations avoided raising the floor level.

CALKING LEAD

Lead is the standard material for calking cast-iron bell and spigot pipe for interior plumbing, water mains, or wherever cast-iron bell and spigot pipe is employed. It can be used in the molten state or in the form of lead wool. Poured joints using molten lead are the most common, but lead wool is ideal where the molten form cannot be used, as in wet ground, under water, or for repairs in gas lines where heat might create a dangerous condition.

Lead for poured molten joints is commercially referred to as calking lead and is obtainable in a number of forms, ranging from pigs weighing 90 to 100 lb. for use in large jobs, to conveniently sized 3 to 5 lb. cakes or ingots for smaller work.

The performance of the completed joint can easily be affected by the purity of the metal used. To insure against low quality material, insist on calking lead meeting the requirements of the U.S. Department of Commerce, Commercial Standard CS94-41, Calking Lead. The chemical requirements of the standard are as follows:

Chemical Requirements for Calking Lead

Lead for calking purposes shall contain not less than 99.73 percent of lead.

Maximum allowable impurities:

	Percent
Arsenic, antimony and tin together	0.015
Copper	0.08
Zinc	0.002
Iron	0.002
Bismuth	0.25
Silver	0.02

To identify easily calking lead meeting these requirements, insist on "Seal of Approval" calking lead. (See page 3.)

Pouring and calking lead in a large water main in New York City.

In the preparation of a calked joint, jute or oakum is driven firmly into the bottom of the joint, leaving about an inch to be filled with lead in the case of soil or waste pipe and two inches in the case of water or pressure pipe.

The weight of lead required for joints in cast-iron soil pipe is approximately 12 oz. of lead per inch of diameter. The accompanying table gives the amount of lead required for joints in cast iron water mains:

Lead has several advantages for making cast iron pipe joints not found in numerous substitutes. It is soft and allows the joint to become deformed due to settling, vibration or expansion and contraction, without leaking. Brittle substitutes, most of which are sulphur base compounds, often crack or cause the pipe to crack.

All rigid pipe lines are subject to strains from ground movement or settlement. If the stresses thus set up can be absorbed by the jointing material, little or no damage to the pipe line can be expected. On the other hand, if the jointing material is brittle and unable to absorb

Pneumatic air-gun being used to calk lead into cast-iron water main joint in Allentown, Pa.

this movement, the joint will undoubtedly fail. If this does not happen, far more serious consequences will occur, such as the pipe itself cracking.

In this connection, perhaps the greatest advantage of lead calked joints where movement has been sufficient to cause leaking is the ease with which they can be repaired. It is costly to shut off water supplies to make repairs to leaky joints, yet that is what must be done if non-calking substitutes for lead are used. If a leak develops in a lead joint, simple calking generally repairs it without a shutdown.

Lead calked joints in underground mains have often served for more than 100 years and have been found sound and in good condition when the mains were ultimately uncovered. No other jointing material has such a performance record. Moreover, when the lead has been cut out upon removal of the pipe, it can and has been actually used to calk the main replacing the older one.

In short, joint leaks are fewer if the joints are made with lead, and if leaks do develop, they are more easily and cheaply repaired.

Calking Materials Required for Lead Joints in Cast Iron Water Mains*

Size of Pipe	*Approximate Weight of Lead per Joint 2 in. Deep Pounds*	*Approximate Weight of Hemp per Joint Pounds*
3	6.00	0.18
4	7.50	0.21
6	10.25	0.31
8	13.25	0.44
10	16.00	0.53
12	19.00	0.61
14	22.00	0.81
16	30.00	0.94
18	33.80	1.00
20	37.00	1.25
24	44.00	1.50
30	54.25	2.06
36	64.75	3.00
42	75.25	3.62
48	85.50	4.37
54	97.60	6.25
60	108.30	8.25
72	146.00	12.50
84	170.00	15.00

*Cast Iron Pipe Research Association

Left, a twelve-inch lead calked cast-iron water main in Denver, Colo. after being lowered 3 ft. and moved horizontally 2 ft. under pressure, lies in a perfectly dry ditch indicating total absence of leaks. Below, lead being poured into a cast iron joint in Riverside, Conn.

SHOWER PANS

With the increasing importance of stall showers in general building plans, it is important to consider the proper waterproofing of these fixtures if eventual damage to walls and ceilings below, with possible rotting or rusting of beams, joints and studs, is to be avoided.

One of the surest methods of overcoming this waterproofing problem is with sheet lead properly installed under the shower floor. The drawing on page 12 illustrates how this should be done.

Lead pans make the most satisfactory waterproofing because lead is absolutely impermeable to moisture, because it is extremely durable and inexpensive, and because the lead conforms easily to the usually uneven surface to be covered. More rigid materials may have voids beneath them and after the tile floor is laid and walked on, the rigid material yields and causes the tile to crack. The lead pan is also flexible enough to allow for settling of the building without damage to the pan.

A precautionary measure that will add many years to the life of the pan is to give it a heavy coating of asphaltum both inside and out when laid over a cement or concrete floor. On wood floors it is advisable to cover the floor with tar paper before setting the pan and to coat the inside of the pan with asphaltum.

This procedure is advisable because water which has seeped through cement, concrete or mortar containing free lime may be corrosive to lead as it is to many other common metals. The asphaltum protects the lead during the curing period of the cement. After the cement has completely carbonated, this danger no longer exists.

The lead pan should have upstands at least 6 in. high and preferably the studs should be notched at least $\frac{1}{4}$ in. back, the notches extending high enough to take care of the upstand. This will then catch any water that may come through the tile work above the top of the pan.

The drain should be soldered to the lead pan and weep holes provided just above the pan level.

Cut-away view of the proper method of installing and connecting a lead shower pan to a lead P-trap. Progressive steps in applying the asphaltum and tar paper are also shown.

A shower pan being installed for a battery of showers in a conversion job for the U. S. Navy at Atlanta, Ga. The pan is made of a single sheet of lead with folded corners and laid over tar paper.

Sheet lead pan installed over the entire floor of the 16 x 27 ft. bathroom in the Lamda Chi Alpha Fraternity House at Louisiana State University. The shower area is confined by an additional upstand.

Hub-type lead vent stack flashing on a flat deck roof of a 702-unit housing project in Syracuse, N. Y.

Boot-Type lead vent stack flashings on a 176-unit housing project in Buffalo, N. Y.

LEAD VENT STACK FLASHINGS

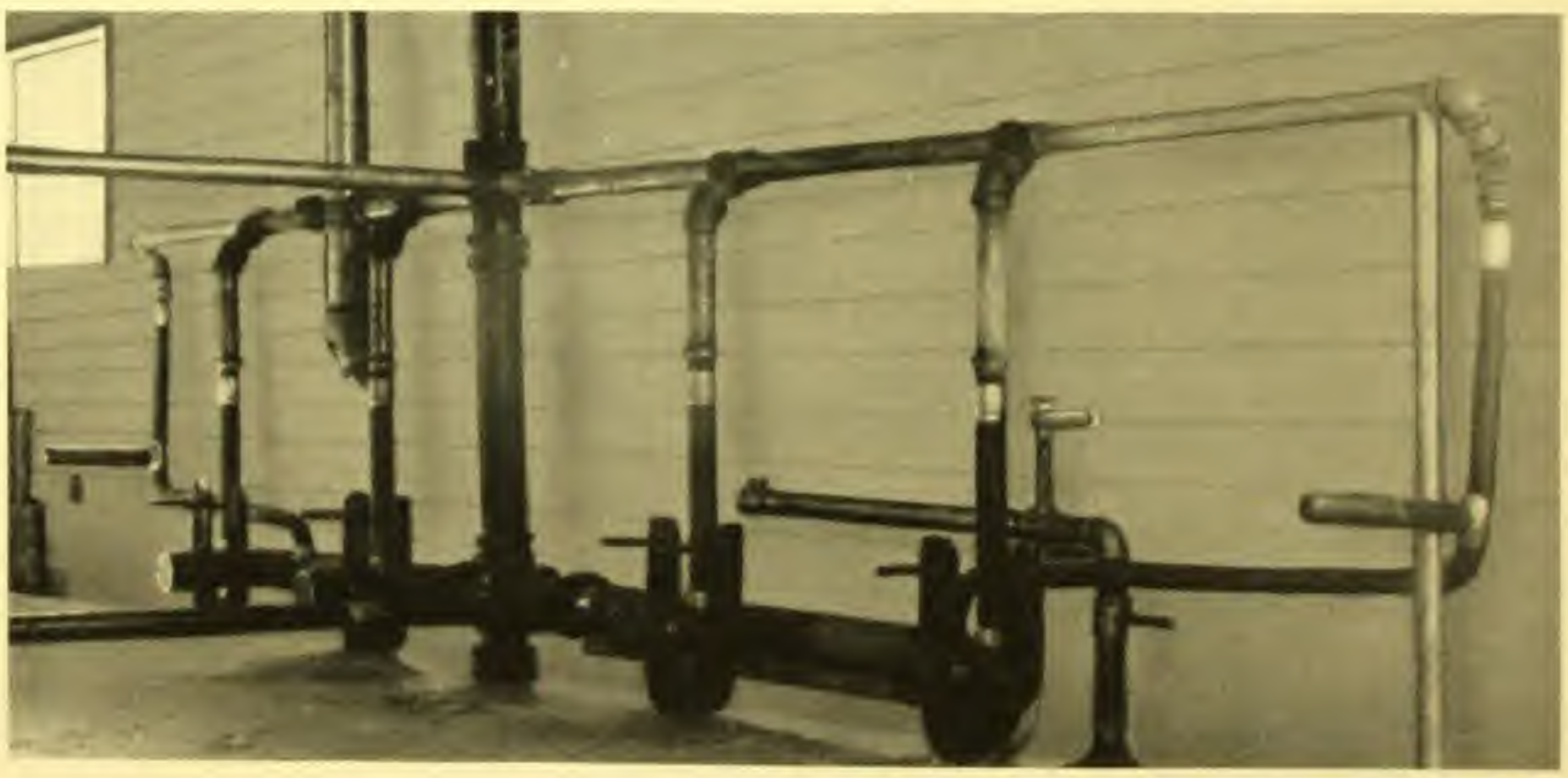
Lead is one of the most durable of the common metals when exposed to the atmosphere. For this reason alone, it would be the preferred material for flashings, particularly for vent stacks piercing the roof. In addition to its durability, however, lead provides these flashings with the necessary flexibility to take up any movement between the vent stack and roof that would tend to destroy other less flexible materials.

Leaks that develop through faulty flashings of vent stacks are usually not discovered until considerable damage to the interior of the building has occurred. Therefore, if this is to be prevented, it is important that lead with its many advantages be used to flash vent stacks.

The pleasing gray patina that lead develops upon exposure to the air blends well with any color scheme. More important, this patina is a strongly adherent film that is insoluble and therefore non-staining. This is particularly important on pitched roofs where any resulting stains can mar the roof and side walls.

Lead vent stack flashings are usually made from sheet lead with the seams welded or soldered. (See drawing on page 11). Lead vent stack flashings cast in one piece are also readily available.

Lead waste and vent connections and horizontal 4-in. lead soil pipe with lead bends and stubs for wall hung closets installed in the power house at Grand River Dam, Oklahoma.



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